Design and simulation of Li-Fi system transceiver

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Design and simulation of Li-Fi system transceiver

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ABSTRACT

The communication system has developed rapidly through the recent years, and the increase within the bandwidth usage that led to its congestion specially in WiFi technique, it's paramount that's found an alternate or a faster means of communication. Light Fidelity is one technique that is used as competitive solution to WiFi, i.e, LiFi is one type of visible light communication that utilized the visible light to send data. In Li-Fi, the information is transmitted in several bit-streams through high-speed flickering of the LED bulb and decoded on the receiver side which consists of a photo detector. This happens within the sort of a binary transmission of knowledge, where '0' is that the LED in its 'offstate' and '1' is that the LED in its 'on-state'. In this paper, it has been designed and simulated a visible light communication system based on Li-Fi technology, that transmits an audio signal, rectangular signal and text. With the aid of Protues 8 and Multisim software programs in the simulation design circuits to send square wave signal and using Arduino to send text message. It has performed a wired circuit design to transmit an audio signal, in the receiver end it's tried to obtain the received signal with less distortion and enhancing the system performance.

1. Procedure

1.1 Audio signal transmission design

Data is transmitted by modulating the intensity of the light, which is then received by a solar panel or photo diode, and the light signal is demodulated into an electronic form. VLC consists of a light source as a transmitter and detector as a receiver. At the receiver side, a solar panel will receive the light signal and correspondingly generate an electrical signal that fed to a speaker produced the same audio signal that was sent, this is shown in figure 1. [10]

Figure 1. Circuit design of audio signal transmission (left), and signal reception (right)

Text message transmission design

In this part, the circuit is designed to transmit the text message using simulation by proteus software, the circuit diagram was built as shown in figure 2. The chosen text message "welcome to LiFi" will be sent from transmitter and processed through the arduino which is converted into digital stream. At the receiver the operation is reversed to decode the original message at LCD screen.
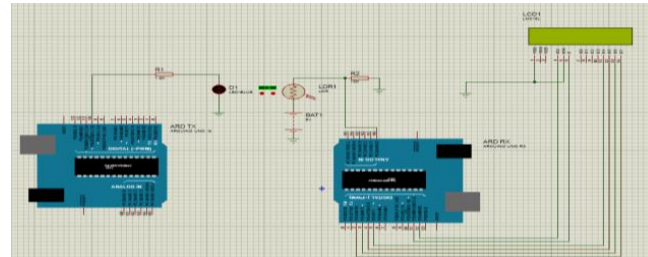

Figure 2. Simulated circuit design to transmit text message using LEDs.

1.2 Transmission design of special signals

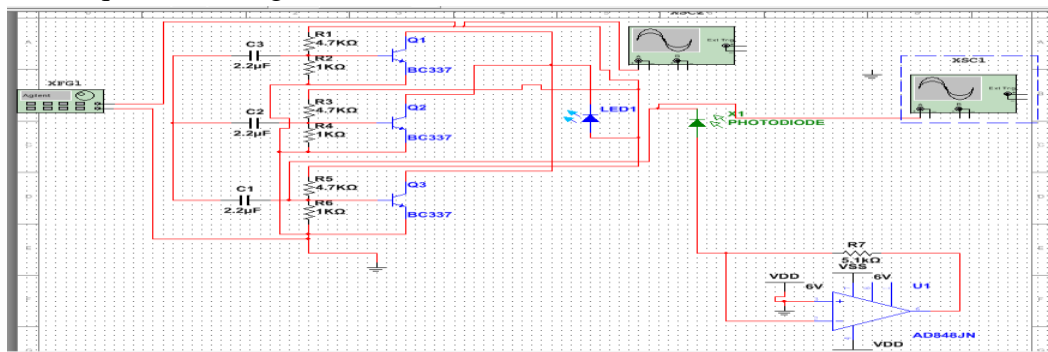a. Square wave signal transmission

Figure 3. Design circuit to transmit square wave signal.
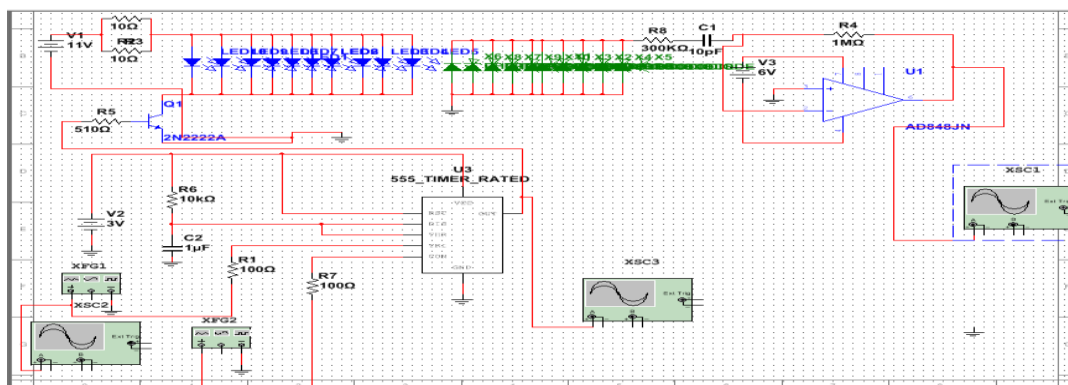
b. PWM signal transmission

Figure 4. Design circuit to transmit and receive PWM signal using Multisim.

2. Results and Discussion

The circuit hardware of Audio signal transmission is shown in figure 5

Figure 5. wired circuit design of transmitter (left), and receiver (right).

Figure 6 shows the graph of system performance vs light intensity and distance.
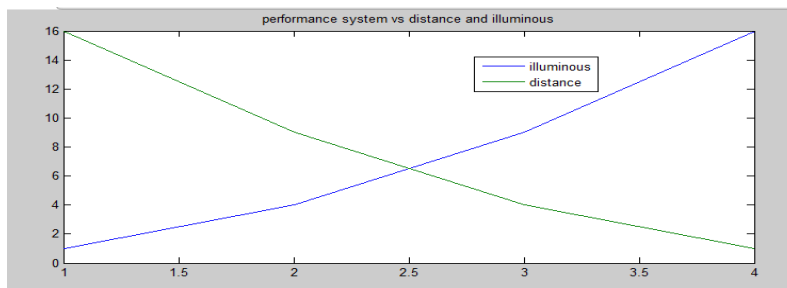

Figure 6. The graph of system performance vs distance and luminance intensity.

When sending a message, the transmission circuit Combines the code of the text in arduino, At the receiver, the LCD screen will display the result. If the message " Welcome to Li-Fi" was sent, the output will appear at LCD as shown in figure 7.
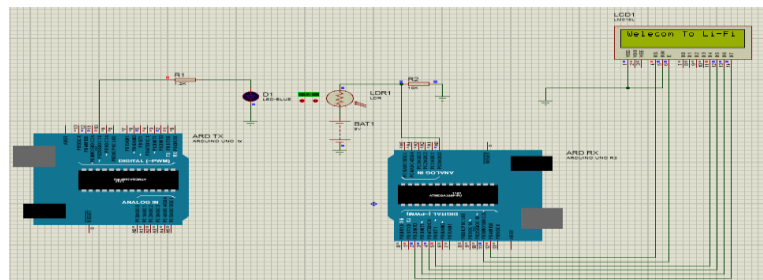

Figure 7. A text message "Welcome to LiFi" was sent and received on LCD.

Later, a square signal is chosen to be transmitted, it's noticed the received signal as shown on the oscilloscope of figure 8.
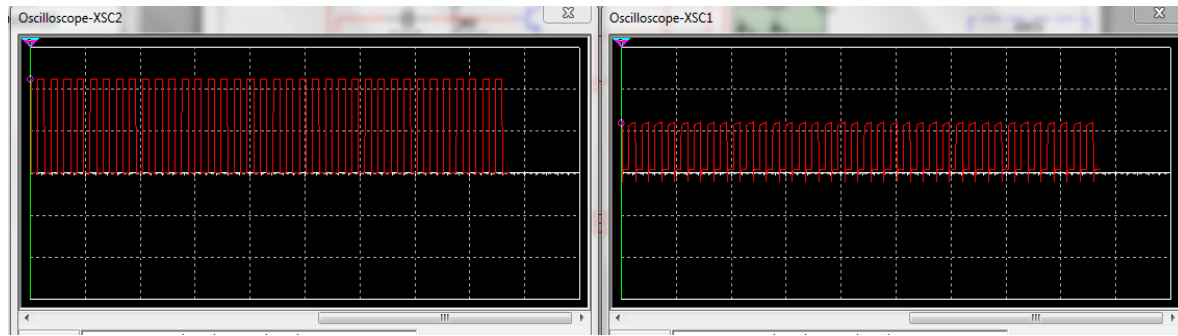
Figure 8. The transmitted signal (left) and the received signal (right)

In the last task of sending PWM, The result of the output signal is displayed on the screen of the oscilloscope is shown in figure 9. It's noticed distortion in the received signal, This can be eliminated by increasing the frequency and the amount of signal transmitted and the addition of operational amplifier in the reception circuit. More over some components like resistors and transistors will affect the output signal.
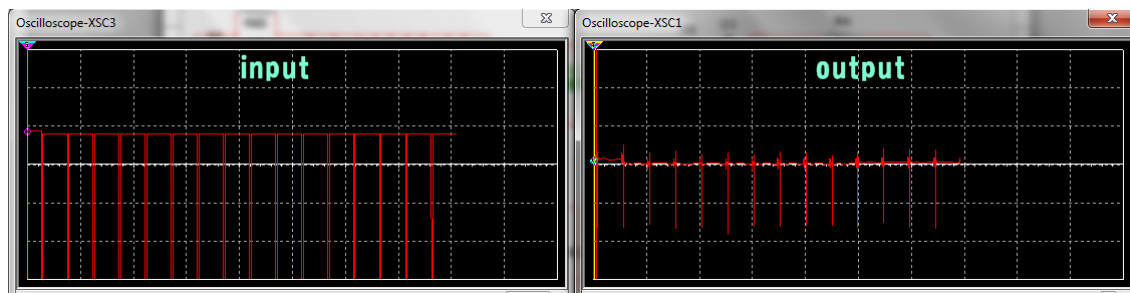

Figure 9. PWM transmitted signal (left) and the received signals (right)

3. Conclusion

Li Fi Technology is a method to transmit any signal from one point to another, it's considered as visible light communication, i.e, uses light to send data. Due to its high speed for transmission and its free bandwidth spectrum made LiFi more suitable and secure than WiFi. In this paper, the design of VLC communication system based on Li-Fi is operating with performance and can be received the original signal with minimum error. Three models of Li-Fi system were designed and simulated. In the first model, it's practically connected a circuit to send and receive an audio signal, that is transmitted through the LEDs, and received through the solar panel, the audio signal can be heard clearly using loud speaker. It's concluded the maximum distance to

transmit reaches to about 5m. The other model is used to simulate a circuit to transmit a message signal from PC to another with a help of Proteus design Software. Finally it will be able to transmit square wave and PWM signal using Multisim software and tried to receive a signal with low noise.